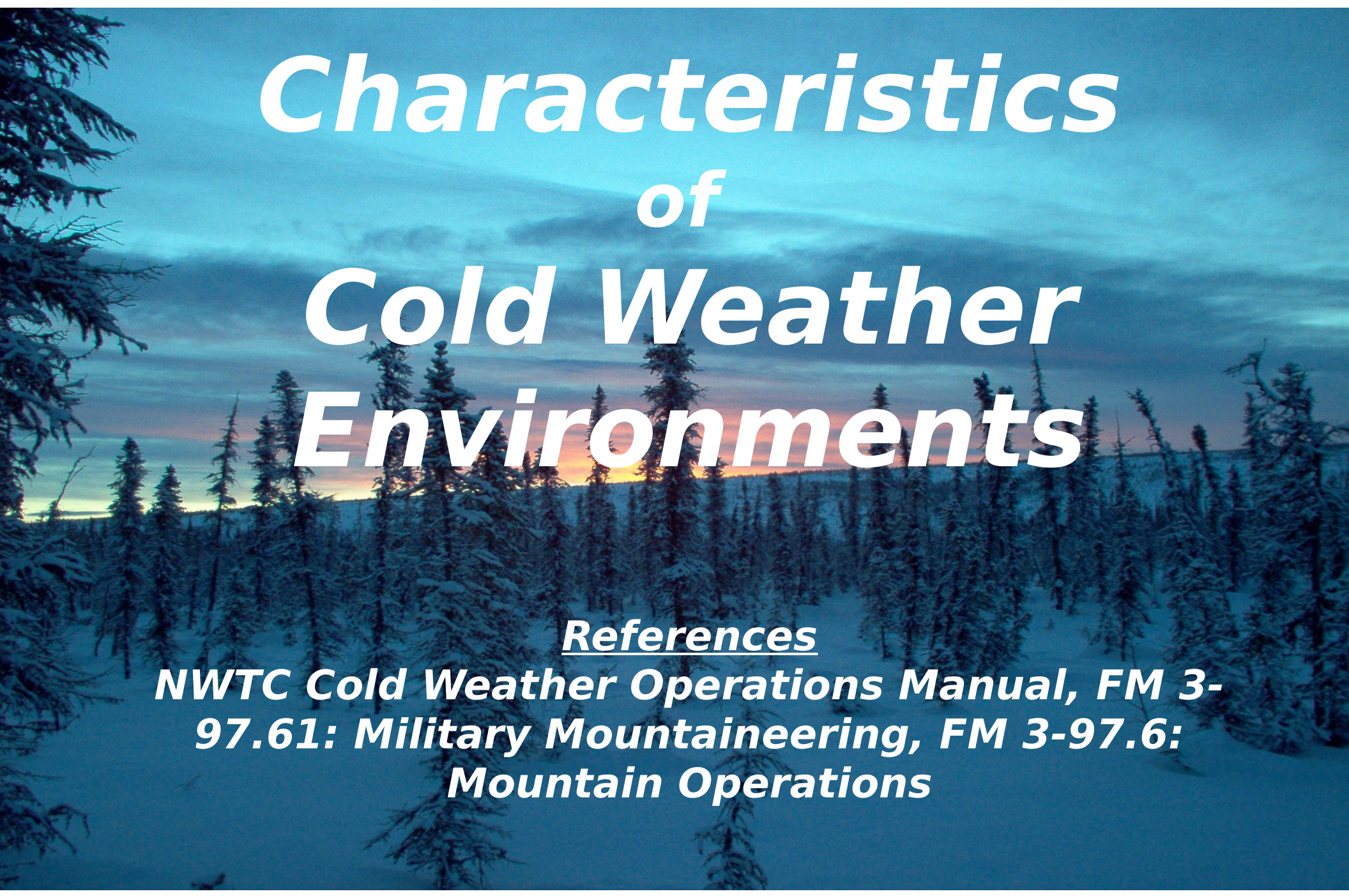


Characteristics of Cold Weather Environments

References

NWTC Cold Weather Operations Manual, FM 3-97.61: Military Mountaineering, FM 3-97.6: Mountain Operations

Characteristics of Cold Weather Environments

- ***Climate Zones and Types of Cold***
- ***Cold Regions of the World***
- ***Terrain Characteristics of Cold Regions***
- ***Weather***
  - ***Weather Prediction***
  - ***Weather Patterns***
  - ***Clouds***

- ***Hazards and Phenomena of Cold***

Climate Zones and Types of Cold

Continental Zone

Light to heavy precipitation

Strong winds common

Hot summers / cold winters

Maritime Zone

Moderate to heavy precipitation

Winds from large bodies of water

Cool summers / mild winters

Cold Wet Conditions

Temperature- ranges from 14°F and above

Precipitation- rain, sleet, snow (wet or dry)

Ground- muddy, wet slushy snow

Constant freeze / thaw cycle

Cold Dry Conditions

Temperature- ranges from 14°F and below

Precipitation- dry snow

Ground- frozen throughout winter

Freeze / thaw cycles are rare

Cold Regions of The World

Arctic

Sub-Arctic

Temperate

Mountainous

Arctic Region

Cold winds / little moisture

Dry climate

Extremely high winds not uncommon

Summer temperature range of 44-51ºF; record high of 79ºF

Winter temperature range of -19 - -26ºF; record low of -54ºF

Snow cover 9 months per year

Arctic Region

Sub-arctic Region

Strong winds

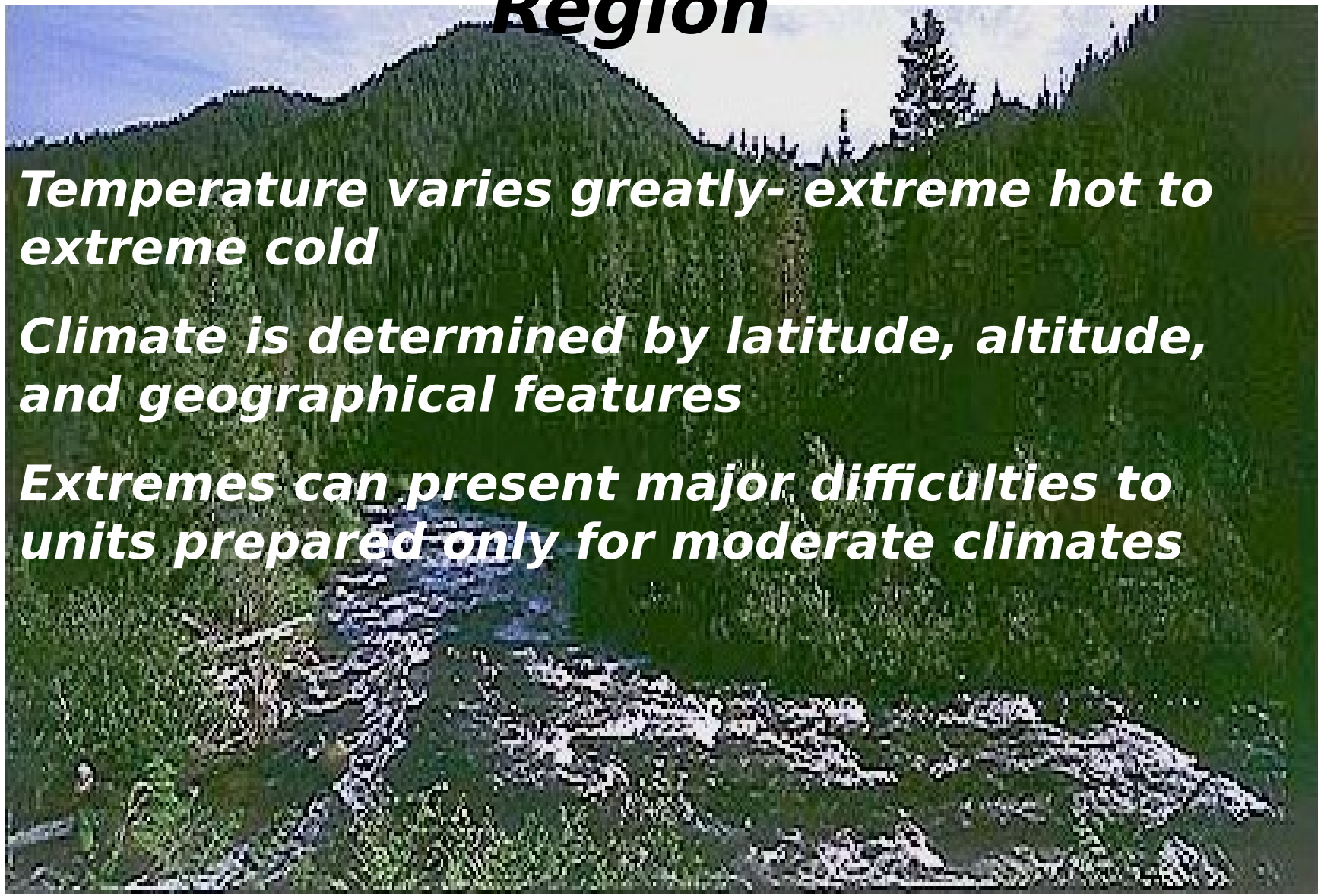
Summer temperature range of 66-73ºF; record high of 96ºF

Winter temperature range of -15 - -19ºF; record low of -62ºF

Snow cover 6 months per year

Sub-Arctic

Temperate Region



Temperature varies greatly- extreme hot to extreme cold

Climate is determined by latitude, altitude, and geographical features

Extremes can present major difficulties to units prepared only for moderate climates

Mountainous Terrain

Compounds the difficulties of fighting in cold regions

Weather is difficult to predi

Presents obstacles to groun and air operations

Re-supply and casualty evacuation are often not possible by air or vehicle

Best terrain for small, self-supported units

Terrain Characteristics

Forested Areas

Tundra

Permafrost

Muskeg

Glaciers and Ice Caps

Rivers

Forested Areas

Uncommon or absent in arctic regions

Moderate in sub arctic regions

Dense in temperate regions

Tundra

Common in Arctic

Normally covered in tussocks

Difficult to move through in summer

Tundra

Tundra

Muskeg

Ground soft and spongy

Many standing pools of water

Very difficult to drive through in summer

Muskeg

Permafrost

Permanently frozen ground

Ground temperature 32°F or less for 2 or more years

Continuous in the Arctic

Discontinuous in Subarctic and further south

Temperate regions free from permafrost

Permafrost

(cont.)

- Thickness varies from a few feet to over 1000 feet
- Tundra keeps permafrost from thawing
- Frozen ground prevents drainage
- Fighting positions difficult to dig

Glaciers and Ice Caps

Covers 10% of Earth's surface

Alaska has 2% of the Earth's glaciers

Often the easiest and safest means of travel in the mountains, but specialized training is required for negotiating

Glaciers and Ice Caps

Rivers

Majority of Arctic and Sub-Arctic rivers are glacier fed

Good transportation routes after freeze up

Rivers

Rivers

Weather

Weather results from:

Atmosphere, oceans, land masses, heating and cooling from the sun and the earth's rotation

Weather depends upon:

Air temperature, humidity, air pressure, how air is being moved and if the air is being lifted or not

You should observe:

Pressure, wind direction/speed, cloud cover, temperature and humidity to help predict weather

Some tools that you can use are thermometer, barometer/altimeter and wind meter.

Cloud Formation

***Convective Lifting*:** **Sun's heat radiating off the earth's surface causing air currents (thermals) to rise straight up and lift air to point of saturation.**

***Frontal Lifting*:** **A front is formed when two air masses of different moisture content and temperature collide. Since air masses will not mix, the warmer air will lift until it reaches its saturation point. Produces majority of precipitation.**

***Cyclonic Lifting*:** **An area of low pressure pulls air into its center from all over in a counterclockwise direction. Once air reaches the center of low pressure, it has nowhere to go but up. Air continues to lift until it reaches the saturation**

Cloud Formation

(cont.)

***Orographic Lifting*:** **This happens when an air mass is pushed up an over a mass of higher ground such as a mountain. This is typical along coast regions with mountains. As the air mass moves up the mountain range, the moisture is released quickly and typically produces heavy precipitation. This is evident in the Cascade Range of the Pacific Northwest.**

Cloud Types

Low Level

Mid Level

High Level

Vertical-Development Clouds

Less Common Clouds

Low-Level Clouds: ***Either Cumulus or Stratus; mostly composed of water; two of the precipitating low level clouds are Nimbostratus clouds and Stratocumulus clouds***

Cumulus Clouds: Low level; fair weather

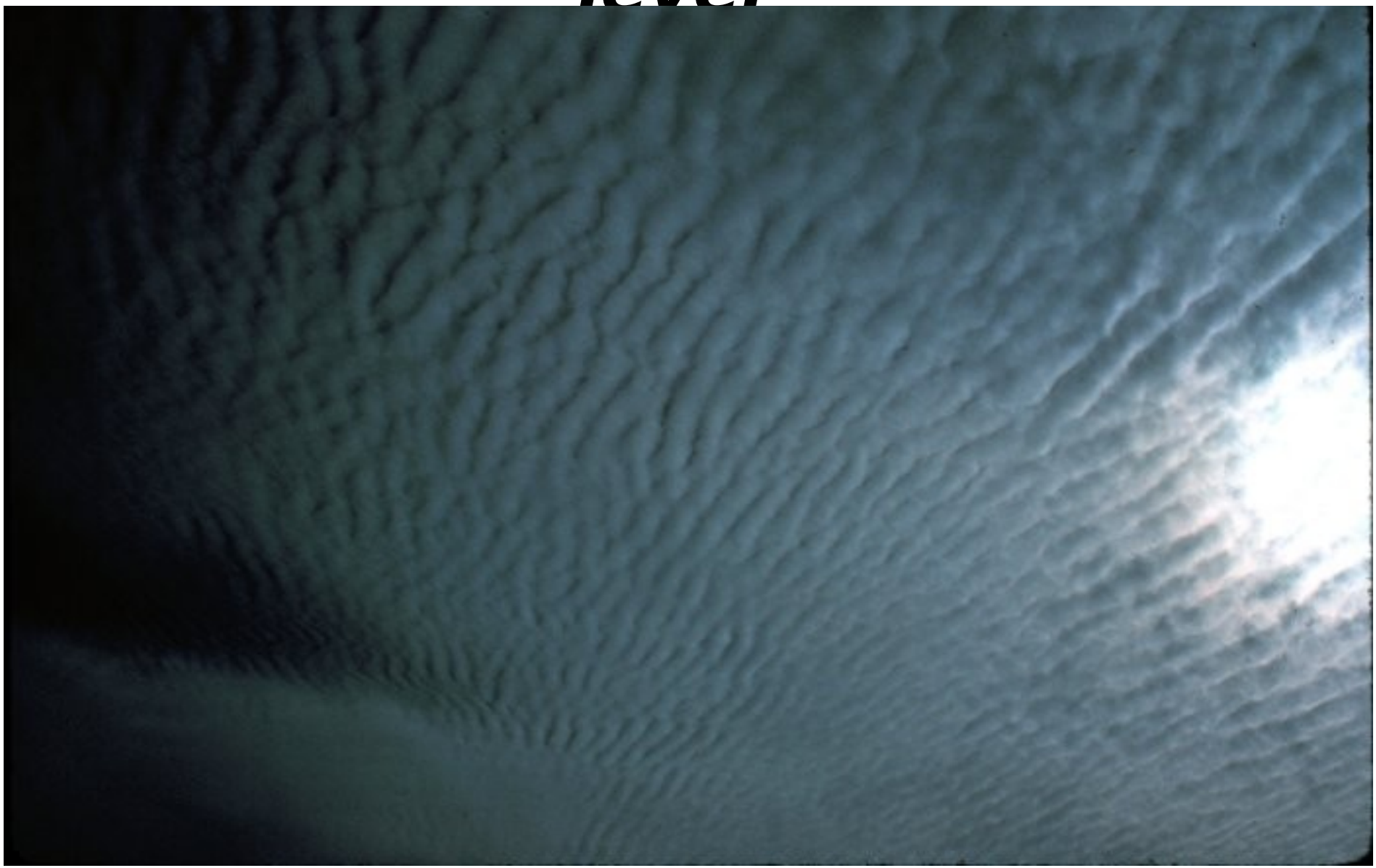
Stratus Clouds Low level: fair weather

Nimbostratus Clouds: Low level

Stratocumulus Clouds: Low level

<u>Mid-Level Clouds:</u> ***Middle clouds generally indicate fair weather, especially if they are rising over time. These clouds have the prefix ‘alto’. Deteriorating weather is indicated by lowering middle clouds though these storms are usually hours away.***

Altocumulus Clouds: Mid level



Altostratus Clouds: Mid level

<u>High-Level Clouds:</u> ***These clouds are in the upper reaches of the troposphere and indicate moisture aloft and that precipitation is 24-36 hours away. Cirrus and Cirrostratus are the most common. The only indicators of these clouds may be a halo or ring around the moon or sun.***

Cirrus Clouds: High level

Cirrostratus Clouds: High

Vertical Development Cloud Formations

Fair Weather Cumulus: ***resemble floating cotton balls with a short lifespan***

Cumulonimbus: ***generally in the shape of anvils. Produce the majority of thunderstorms.***

Cumulonimbus Clouds: Thunderhead

Less Common Cloud Formations

Orographic or Lenticular Clouds:
Look similar to contact lenses. Indicate poor weather in the near future.

Contrails: ***Exhaust from jets creates clouds in the upper atmosphere; evaporate quickly in fair weather; contrails that takes longer than 2 hours to evaporate indicate impending bad weather***

Lenticular Clouds

Lenticular Clouds

Fronts

Warm Front: warm air mass moves into and over a cold air mass; forms cirrus, cirrostratus, nimbostratus, and fog.

Cold Front: cold air mass overtakes a slower or stationary warm air mass; cold air forces the warm air up; forms cirrus, cumulus and then cumulonimbus producing a short period of showers

Occluded Front: Occurs frequently over land; progress from cirrus to cirrostratus to altostratus to nimbostratus (precipitation)

Stationary Front : no significant air movement; clear to partly cloudy weather along the front

Weather Prediction

Some of the indicators that weather conditions will change/deteriorate significantly in the near future are:

- ***Thickening, lowering clouds***
- ***Lenticular Cloud formation***
- ***Marked wind increases or direction shifts***
- ***Marked change in temperatures***
- ***Decreasing barometric pressure***

Hazards and Phenomena of Cold Regions

Wind Chill

AIR TEMPERATURE IN FAHRENHEIT

WIND SPEED	40	35	30	25	20	15	10	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45
5	36	31	25	19	13	7	1	-5	-11	-16	-22	-28	-34	-40	-46	-52	-57	-63
10	34	27	21	15	9	3	-4	-10	-16	-22	-28	-35	-41	-47	-53	-59	-66	-72
15	32	25	19	13	6	0	-7	-13	-19	-26	-32	-39	-45	-51	-58	-64	-71	-77
20	30	24	17	11	4	-2	-9	-15	-22	-29	-35	-42	-48	-55	-61	-68	-74	-81
25	29	23	16	9	3	-4	-11	-17	-24	-31	-37	-44	-51	-58	-64	-71	-78	-84
30	28	22	15	8	1	-5	-12	-19	-26	-33	-39	-46	-53	-60	-67	-73	-80	-87
35	28	21	14	7	0	-7	-14	-21	-27	-34	-41	-48	-55	-62	-69	-76	-82	-89
40	27	20	13	6	-1	-8	-15	-22	-29	-36	-43	-50	-57	-64	-71	-78	-84	-91
45	26	19	12	5	-2	-9	-16	-23	-30	-37	-44	-51	-58	-65	-72	-79	-86	-93
50	26	19	12	4	-3	-10	-17	-24	-31	-38	-45	-52	-60	-67	-74	-81	-88	-95

WIND SPEED BASED ON MEASURES AT 33 FEET HEIGHT. IF WIND SPEED MEASURED AT GROUND LEVEL, MULTIPLY BY 1.5 TO OBTAIN WIND SPEED AT 33 FEET IN HEIGHT AND THEN UTILIZE CHART.

Ice Fog

Temperatures are -30º F or colder; heat or vapor source present and still air conditions

Obscures vision and target recognition

Hinders movement

Leaves signature when weapons are fired or vehicles are operated

Numerous supplementary positions are needed for weapons

Can be used to conceal your movement

Blizzard

High winds

Blowing snow

Reduced visibility

Usually lasts 24 hours or less

Whiteout

Loss of Depth Perception

Units Should Stop and Wait Condition out

Temperature Inversion

Cold air settles in low areas;

warm air settles on top of cold

Can be 20°F difference

Bivouac site selection

Looming

Optical illusion that causes objects to appear closer than they actually are; causes problems with range estimation

Normally occurs in extreme cold dry air

Chinook Winds

These are warm, dry winds that occur in the lee of high mountain ranges. It is a fairly common wintertime phenomena in the mountainous west and in parts of Alaska. These winds develop in well-defined areas and can be quite strong.

Aurora Borealis

Caused by Charged Particles Produced by the Sun

Occur All Year

Aurora Borealis Activity Can Adversely Effect AM and satellite communications but may enhance FM communications

In Southern Hemisphere Called Aurora Australis

Aurora Borealis

Summary